Lab 6, Ground Floor, Fr. Roque Ruaño Bldg., España Boulevard, Sampaloc, Manila, Philippines 1500
(632)406-1611 loc. 8516

EXPERIMENT NO. 7
FLOW METER DEMONSTRATION

OBJECTIVE:

This activity aims to investigate the operation and characteristics of three different basic types of flow meter, including accuracy and energy losses.

APPARATUS AND SUPPLIES

Hydraulics Bench
Flow Meter Apparatus
Stopwatch

EQUIPMENT SET UP PROCEDURE

1. Place the flow meter test rig on the bench and ensure that it is level (necessary for accurate readings from the manometers).
2. Connect inlet pipe to the bench supply and the outlet pipe into the volumetric tank, and then secure the end of the pipe to prevent it moving about.
3. Start the pump and open the bench valve and the test rig flow control valve, to flush the system.
4. In order to bleed air from the pressure tapping points and manometers, close both the bench and test rig valves, open the air bleed screw and remove the cap from the adjacent air valve.
5. Connect a length of small-bore tubing from the air valve to the volumetric tank.
6. Next, open the bench valve and allow flow through the manometer tubes to purge them of air.
7. Then tighten air bleed screw and partly open the test rig flow control valve and partly close the bench valve.
8. Now, open the air bleed screw slightly to allow air to be drawn into the top of the manometer tubes.
9. Re-tighten the screw when the manometer levels reach a convenient height.
10. Check that all manometer levels are on scale at the maximum flow rate. These levels can be adjusted further by using the air bleed or the hand pump supplied.

PROCEDURE

1. At a fixed flow rate, record all manometer heights and the variables area meter reading and carry out a timed volume collection using the volumetric tank. This is achieved by closing the ball valve and measuring the time taken to accumulate a known volume of fluid in the tank, as measured from the sight-glass. You should collect fluid for at least one minute to minimize timing errors.
2. Repeat this measurement twice to check for consistency and then average the readings.

DISCUSSION

The following dimensions are used in the appropriate calculations. If required these values may be checked as part of the experimental procedure and replace with your own measurements.

For the Venturi Meter

Upstream Pipe Diameter	=	*0.03175*	*m*
Cross sectional area of upstream pipe, A_1	=	*7.92×10^{-4}*	*m^2*
Throat diameter	=	*0.015*	*m*
Cross sectional area of throat, A_2	=	*1.77×10^{-4}*	*m^2*
Upstream Taper	=	*21*	*degrees*
Downstream Taper	=	*14*	*degrees*

For the Orifice Plate

Upstream Pipe Diameter	=	*0.03175*	*m*
Cross sectional area of upstream pipe, A_1	=	*7.92×10^{-4}*	*m^2*
Throat diameter	=	*0.020*	*m*
Cross sectional area of throat, A_2	=	*3.14×10^{-4}*	*m^2*

The manometers are connected so that the following pressure differences can be obtained.

$h_1 - h_2$	Venturi meter reading
$h_1 - h_3$	Venturi loss
$h_4 - h_5$	Variable area meter loss
$h_6 - h_7$	Orifice plate reading
$h_6 - h_8$	Orifice plate loss

DATA AND RESULTS:

Table 7.1a

	Test Pipe Area A_1 (m^2)	Orifice Area A_2 (m^2)	Venturi Area A_2 (m^2)	Volume Collected V (m^3)	Time to Collect t (sec)	Variable Area Meter Reading (l/min)	h_1 (mm)	h_2 (mm)	h_3 (mm)	h_4 (mm)	h_5 (mm)	h_6 (mm)	h_7 (mm)
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													

Table 7.1b

	h_8 (mm)	Time Flow Rate Q_t (m^3/s)	Variable Area Flow Rate Q_a (m^3/s)	Orifice Plate Flow Rate Q_o (m^3/s)	Venturi Meter Flow Rate Q_t (m^3/s)	Variable Area % Flow Rate Error (%)	Orifice Plate % Flow Rate Error (%)	Venturi Meter % Flow Rate Error (%)	Variable Area Head Loss (H_a)	Orifice Plate Head Loss (H_o)	Venturi Meter Head Loss (H_v)	Time Flow Rate Squared (Q_t^2)
1												
2												
3												
4												
5												
6												
7												
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10												
11												

APPLICATION OF THEORY

- Comment on the differences in accuracy of the meters. Could these differences be due to experimental error?
- Why does the variable area meter show less variation in head loss with flow rate than the other two meters?

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EXPERIMENT NO. 7
FLOW METER DEMONSTRATION

Year and Section		**Date Started**	
Group Number		**Date Finished**	
Group Members		**Date Submitted**	

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7.1 DATA AND RESULTS:

Table 7.1a

	Test Pipe Area A_1 (m^2)	Orifice Area A_2 (m^2)	Venturi Area A_2 (m^2)	Volume Collected V (m^3)	Time to Collect t (sec)	Variable Area Meter Reading (l/min)	h_1 (mm)	h_2 (mm)	h_3 (mm)	h_4 (mm)	h_5 (mm)	h_6 (mm)	h_7 (mm)
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Table 7.1b

	h_8 (mm)	Time Flow Rate Q_t (m^3/s)	Variable Area Flow Rate Q_a (m^3/s)	Orifice Plate Flow Rate Q_o (m^3/s)	Venturi Meter Flow Rate Q_t (m^3/s)	Variable Area % Flow Rate Error (%)	Orifice Plate % Flow Rate Error (%)	Venturi Meter % Flow Rate Error (%)	Variable Area Head Loss (H_a)	Orifice Plate Head Loss (H_o)	Venturi Meter Head Loss (H_v)	Time Flow Rate Squared (Q_t^2)
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7.2 FORMULAS AND COMPUTATIONS:

7.3 DRAWINGS/SKETCHES/DIAGRAMS/GRAPHS:

7.4 SOURCES OF ERRORS:

7.5 REMARKS/CONCLUSION: